Monitoring services of ponds in Šilutė H. Šojaus park and Maras pond in Kuldīga city

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Final report

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1. Object and tasks

The Maras Pond is located on the outskirts of Kuldīga city, adjacent to the Alekšupīte stream. It is a small (approximately 0.3 ha) partially flowing water body with a regulated water level. The eastern and southern slopes of the pond are relatively steep, partially covered with trees, and shaded for much of the day. The bottom substrate consists predominantly of silt mixed with sand and fallen tree debris. The pond is characterized by relatively high water transparency (>2 m) and supports abundant aquatic vegetation, primarily composed of species from the families *Lemnaceae* and *Ceratophyllaceae*.

Figure 1 Maras pond in the city of Kuldīga (source: https://maps.google.com/).

Figure 2. Maras Pond (Kuldīga) prior to (left) and following (right) the cleaning works (foto: E. Ivanauskas).

Tasks:

1. To evaluate the water quality of the ponds before the pond cleaning works and after the end of the works using the LŽI index method.;

2. To evaluate the water quality of the ponds before and after the pond cleaning works, using the vegetation community assessment index;

3. To carry out an assessment of pond biodiversity and the abundance of rare species before and after the pond cleaning works.

2. Methodology

2.1 Fish survey

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Total or absolute and zoological (without caudal fin) fish length, mass, and age were evaluated as empirical parameters. Species classified the fish caught during the survey weighed (Q, g), the total length of the fish (L, cm), and the length without the tail fin (l, cm) were measured, and scales were taken for age determination. A ruler with an error of 1 mm was used for measurement. An electronic scale with an error of 1 g was used to weigh the catch. The age of the fish was determined from scales in the laboratory using binoculars according to the appropriate methodology (Bukelskis and Kublickas, 1988; Thoresson, 1993; Pravdin, 1966).

In the Maras pond of the city of Kuldīga, ichthyological survey were carried out using a specialized trap net for catching fry, as well as hand net.

2.2 Macroinvertebrate survey

Macroinvertebrates were sampled using a D-net. For each water body, three locations were selected and invertebrates were caught in them for 5 min. A 30*30 cm pool bottom area with sediments and plants was taken for quantitative samples.

2.3 Macrophytes

Macrophyte survey in the Kuldīga Maras pond should be carried out at the same time as ichthyological ones. The survey was carried out under the guidance of the Minister of the Environment of the Republic of Lithuania in 2013. December 16 by order no. D1-934 approved methodology. Investigations were carried out in 3-4 transects in each surveyed pond, in < 1 m, 1-2 m and > 2 m depth zones. In the smallest zone, up to 1 m deep, the abundance of different macrophyte species was assessed visually, by grabbing plants with a hook only to confirm the accuracy of species identification. In the deeper zones, macrophytes were scooped out with a hook in at least 3 places in each of the zones.

All macrophytes found during the survey have been identified as species. The abundance of each species in each depth zone was assessed on a 5-point scale: 1 – species very rare, 2 – rare, 3

– not rare, 4 – common, 5 – very common/dominant. Each identified species of macrophytes is assigned to ecological-morphological groups: submerged (*potameida* and *limneida*), floaters (*nymphidae*), free-floating plants (*lemnida*), and helophytes.

For the calculation of the MEI of lakes, submerged, floating and free-floating macrophytes are divided into 3 groups of indicator species: A – species sensitive to anthropogenic impact (species characteristic of reference lake communities); B – indifferent species; C - tolerant species (usually growing where there are very few or no species of group A). Following the approved methodology (Žin. 2013), the assignment of species to indicator groups was carried out by accounting for the average depth of the pond.

3. Results

This section presents the results of the survey and a summary of the results.

3.1. Macroinvertebrates

3.1.1. Diversity of macroinvertebrates

The invertebrate species composition found in Maras Pond is typical for such small flowing water bodies, where small bristle worms, mollusks, leeches and insect larvae predominate. No crustaceans (Aseluus aquaticus) were detected after cleaning, these crustaceans prefer muddy bottoms, and after cleaning the silt layer in the pond may have decreased, which worsens the living conditions for these crustaceans. No protected species were found in the water body. According to the average abundance of macroinvertebrates, a higher abundance of invertebrates was found after cleaning (Table 1)

Table 1. Average abundance of macroinvertebrate taxa (ind./sq.m) in the surveyed water bodies

Taxe	**Abundance, ind./kv.m.**	
	2025	**2024**
Oligochaeta	11	89
Erpobdella sp.	30	52
Asellus aquaticus	0	85
Caenis sp.	585	115
Chironomidae	252	48
Valvata sp.	0	33
Bithynia	133	0
kiti	192	78
Total	1202	500

3.2. Macrophytes

Figure 2 presents the transects where aquatic plant surveys were conducted in Maras Pond during both survey years. Similar to the results of 2024, the 2025 survey revealed a very low abundance of aquatic plant species; therefore, the Macrophyte Ecological Index (MEI) was not calculated. According to the Order of the Minister of the Environment of the Republic of Lithuania “On the approval of the methodology for determining the condition of surface water bodies”, Section 9 “Requirements for calculating the MEI of the transect”, Subsection 9.2 stipulates that for water bodies with an average depth of less than 3 m, the total plant coverage must be ≥35 and species of Nymphaea and Nuphar must constitute less than 80% of the total plant content. Since these criteria were not met due to the insufficient number of macrophyte species in Maras Pond, the MEI was not determined. Nevertheless, the relative abundance of aquatic vegetation within the pond and along the shoreline was evaluated.

Table 2. Species of aquatic macrophytes found in Maras pond and their relative abundance/coverage.

Species	Relative abundance (overgrowth)%	
	2024	***2025***
LIMNEIDS		
Algae		
Chara sp.	13	32
Moss		
Fontinalis antipyretica	1	-
Flowering plants		
Elodea canadensis	6	17
POTAMEIDS		
Flowering plants		
Potamogeton lucens	15	3
Ceratophyllum demersum	27	5
FLOAT LEAVES AND FLOATERS (NYMPHEIDS, PLEUSTOPHYTES)		
Flowering plants		
Potamogeton natans	23	5
Lemna trisulca	2	-
SHORLINE PLANTS		
Typha latifolia	37	1
Schoenoplectus lacustris	12	1
Schoenoplectus tabernaemontani	3	-
Phragmites australis	22	3

Table 2 presents the aquatic plant species identified in the survey transects of Maras Pond and their overall relative abundance during both survey years. Following the cleaning works, a marked decrease in aquatic vegetation coverage was observed. The total abundance of macrophytes declined significantly, and several species recorded in 2024—Fontinalis antipyretica, Lemna trisulca, and Schoenoplectus tabernaemontani—were not detected during the 2025 survey. This reduction in species richness and cover is likely related to the physical removal of vegetation and disturbance of the littoral zone during the cleaning process. However, a notable increase in the abundance of Chara spp. was observed, suggesting that post-cleaning conditions, such as improved light penetration and reduced competition, may have favored the growth of charophytes. Overall, these results indicate that while the cleaning works effectively reduced excessive macrophyte growth, they also temporarily simplified the aquatic vegetation community structure.

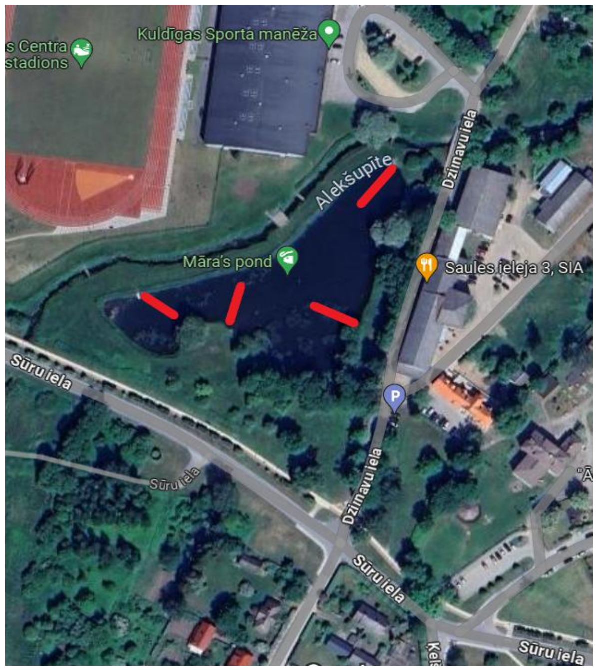

Figure 2. Macrophyte survey transects in the Kuldīga Maras pond. (map from www.maps.lt)

3.2. Fish abundance and biomass

During the 2025 ichthyological survey, six fish species were recorded in Maras Pond: tench (Tinca tinca), roach (Rutilus rutilus), rudd (Scardinius erythrophthalmus), perch (Perca fluviatilis), Prussian carp (Carassius gibelio), and sunbleak (Leucaspius delineatus). One new species, the non-native Prussian carp, was detected in 2025, while pike (Esox lucius) was not caught during sampling but was visually observed in the pond. Table 3 presents the relative biomass and abundance of the fish species caught during the survey. Overall, no major changes in fish species composition were observed compared to previous results, indicating that the cleaning works had not yet caused measurable shifts in the fish community structure. However, the presence of Prussian carp may suggest early stages of colonization by tolerant, opportunistic species that can thrive in disturbed or recovering habitats. Given the relatively recent timing of the cleaning works, further monitoring over the next 3–5 years would be necessary to assess long-term ecological responses, including potential recovery of native fish assemblages, changes in species abundance, and stabilization of community structure.

Table 3. Fish species caught in the Maras pond during the survey, their relative biomass B% and relative abundance N% during years of survey.

Species	**N %**		**B%**	
	2025	2024	2025	2024
Tench	0.3	1.6	9.5	1.6
Roach	26.7	20.8	47.7	20.8
Rudd	14.7	20.1	16.1	20.1
Perch	14.4	7.3	17.8	7.3
Pike	-	0.6	-	0.6
Sunbleak	43.6	49.6	4.8	49.6
Prussian carp	0.3	-	4.1	-

The Maras pond is classified according to its hydromorphological parameters to shallow, often mixed water bodies with an average depth of <3 meters (Table 4). The lake fish index - EŽI (Virbickas, 2016) was used to assess the ecological condition.

Table 4. Criteria for classifying lakes, ponds, and quarries into types ≤3

Types of water bodies in the category of lakes				
Criteria:	**Poly Polymictic**		**S Stratified**	**GS Deep stratified**
Average depth (m)	≤3	>3	>3	*n**
Maximum depth (m)	*n**	<11	11-30	>30

* „*n*“ - criterion is not used

Table 5. Fish indices and their change limits in condition classes.

Types of lakes	Indicators	Benchmark value	Status classes				
			V.good	Good	Average	Bad	V.bad
1 (POLY)	Silver bream Q% [1]	1.5	<4	4-10	11-18	19-25	>25
	Benthivor_Sp Q% [2]	10	<20	20-34	35-46	47-60	>60 (0)
	Perch N% [3]	30	>25	25-18	17-10	9-5	<5
	Obligatory species [4]	6	6	5	4	<4	<4
	Non-native Translocated species Q%[5]	0	-	-	<1	1-5	>5

Description of EŽI indicators:

1 Silver bream Q% - relative biomass of silver breams;
2 Benthivor_Sp Q% - relative biomass of silver breams, common breams, and ruff;
3 Perch N% – relative abundance of perches;
4 Obligatory species: POLY lakes - Bleak, Rude, Pike, Tench, Perch, Roach;
5 Non-native Translocated species Q% - Total relative biomass (%) of individuals of pikeperch, crucian carp, carp, and other non-native species in the fish community;

Table 6. Values of indicators (except for obligatory species and relative biomass of non-native-translocated species) transformed to the EKS scale ("1" - l. good condition, "0" - l. bad condition).

Types of lakes	Indicators	(Maximal value)	Status classes				
			V.good	Good	Average	Bad	V.bad
1 (POLY)	Silver bream Q%_EKS	(30)	1.0-0.913	0.912-0.702	0.701-0.421	0.420-0.175	0.175-0.0
	Benthivor_Sp Q%_EKS	(70)	1.0-0.834	0.833-0.600	0.599-0.400	0.399-0.167	0.166-0.0
	Perch N%_EKS		1.0-0.834	0.833-0.600	0.599-0.333	0.332-0.167	0.166-0.0

The transformation of the indicators presented in Table 6 into the ecological quality ratio (EKS) is carried out according to the formulas below.

Silver bream Q% ir Benthivor_Sp Q% indicators:

EKS = (X-Xmax)/(Xet-Xmax), kur X – set value, Xet – reference value (Table 7), Xmax – theoretical maximum value;

Indicator EKS at the value of >1 or <0 (negative value; indicators of group 1), the value of the indicator is equated to "1" or "0", respectively.

Table 7. EKS value of obligatory species depends on the number of obligate species found in the lake.

Lake type		Number of obligatory species			
	1 (POLY)	6	5	4	<4
Obligatory species EKS		1	-	0,2	0

Note: if one of the obligate fish species is not caught during the survey, but it is known that it lives in the lake, it is added to the other species when determining the EKS indicator of the obligate fish species.

Table 8. Relative biomass (Q%) EKS values of non-native and translocated species

Relative biomass (Q%) indicator of individuals of non-native and translocated species				
Q%	0%, or only 1 individual in the catch per CPUE	<1%	1-5%	≥5%
EKS	- (indicator not used)*	0,5	0,2	0

* - The indicator is used only when more than 1 individual is caught during the standardized fishing effort with 8 selective nets.

The Lake Fish Index (EŽI) is the average of all indicators in the EKS. The change limits of the EŽI index in different condition classes are presented in Table 9. The same EŽI classification system as for lakes is used to determine the ecological potential of ponds.

Table 9. Ecological status/potential classes of lakes according to EŽI values

Types of lakes	**Ecological status classes**				
	V.good	**Good**	**Average**	**Bad**	**V.bad**
1-3	1,00-0,87	0,86-0,61	0,60-0,37	0,36-0,18	0,17-0,00

Table 10. Fish indicators, reference values, ecological quality ratio and their status in classes have been determined in 2025

Indicators	**Set value**	**Ecological quality ratio**	**Benchmark value**	**Status class**
Silver bream Q%_EKS	0	1	1,5	V.good
Benthivor_Sp Q%	0	1	10	V.good
Perch N%	14,4	0.482	30	Average
Obligatory species	5	0.833	6	Good
Non-native Translocated species Q%	1	0.5	<1	Average
EŽI		**0.763**	**-**	**Good**

Table 11. Comparison of fish indicators, reference values, ecological quality ratio, and their condition in the surveyed Maras pond in 2025 and 2024.

Indicators	Ecological quality ratio		Status class	
	2025	2024	2025	2024
EŽI	**0.763**	**0.769**	**Good**	**Good**

According to the ichthyological survey conducted in 2025, the Lake Fish Index (EŽI) value for Maras Pond was 0.763, corresponding to a “good” ecological condition (Table 10). This assessment was primarily influenced by the high number of obligate fish species recorded—roach (Rutilus rutilus), perch (Perca fluviatilis), rudd (Scardinius erythrophthalmus), and tench (Tinca tinca). Although pike (Esox lucius) was not captured during sampling, it was visually observed and therefore included in the index calculation. One non-native, translocated species, Prussian carp (Carassius gibelio), was also caught in 2025. This species had not been recorded in 2024 but was previously suspected to be present in the pond’s fish community. Its detection and inclusion in the index calculation negatively affected the overall EŽI value. Compared to 2024, when the relative abundance of perch was 7.3%, the 2025 survey recorded a higher proportion of this species (14.4%), improving the status class for this indicator from low to moderate. Benthivorous fish were not captured in either year, resulting in a Benthivor_Sp Q% value of 1, indicating a “very good” condition for this metric. No significant changes were observed in the overall fish species composition, abundance, or biomass between the two years, suggesting that the recent cleaning works did not yet have a pronounced effect on the pond’s ichthyological community. The fish assemblage of Maras Pond remains characteristic of small eutrophicated water bodies, where limited habitat diversity and restricted ecological niches constrain species richness and stability. Despite the current “good” ecological assessment based on EŽI indicators, the community remains sensitive to anthropogenic pressures, and future changes in species composition may occur rapidly due to the pond’s small size and shallow depth. Continued monitoring over subsequent years is therefore recommended to assess long-term trends in fish community development and ecological quality.

4. Conclusions

1. The Lake Fish Index (EŽI) results for both 2024 and 2025 classified Maras Pond as being in “good” ecological condition, with little change in overall fish community composition.
2. The detection of the non-native Prussian carp (Carassius gibelio) in 2025, absent in 2024, slightly reduced the EŽI value and suggests early colonization by tolerant species after cleaning works.
3. A moderate increase in perch abundance in 2025 indicated some improvement in the representation of predatory fish.
4. Macrophyte species richness and coverage decreased significantly after the cleaning works, though Chara spp. increased, indicating partial recovery of submerged vegetation.
5. The identified invertebrate species composition is typical for such small water bodies, where insect larvae, mollusks and leeches predominate.
6. Continued monitoring is recommended to evaluate long-term effects of cleaning works on fish community stability and aquatic vegetation recovery.

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